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ANOPHEL. BREEDING IN SEA WATER

THE leading article in the *Atti Della Società per gli Studi della Malaria* for 1907 is by Dr. W. T. de Vogel, of Samarang, Dutch East Indies, and is entitled "Anophelines in Sea Water."

Dr. Vogel shows that the investigations of several Italian workers have negatived the idea that *Anopheles* can multiply in sea water and that they have shown that the maximum proportion of sodium chloride in the water which *Anopheles* can stand is 1.87 per cent. according to Perrone, and 1.75 per cent. according to Vivante. Dr. Vogel, having made some elaborate studies in regard to malaria at Samarang, found as early as 1902 that *Anopheles* was breeding in a certain pool containing 2.8 per cent. of chloride of sodium. Later he verified these results in several interesting cases. One of these was the case of the island of Onrust, a small coral island situated two thousand meters from the mainland, and which contains no fresh water whatever. The distance from the mainland is such that even if *Anopheles* were brought from the mainland by winds they would not be numerous enough to cause much trouble. At the same time a marine station established on the island was suppressed on account of the ravages of malaria among the workmen.

He studied also the conditions in the Karimmon Islands, a little archipelago in the Java Sea sixty-five kilometers from the coast. The first colonists in this archipelago were convicts and were sent there to cut down the forests of rhizopores. There were no buildings, and the convicts were forced to sleep on the earth. The mortality was between two and three thousand in two years. Later one of the officers—a man named Michalofski, a plain man but full of good sense—succeeded in putting a stop to the excessive mortality with the simple means at his disposal, by drying the sea-water pools, completely removing a part of the forest, and raising the ground on which the men slept. The success which followed these measures leads Dr. Vogel to suppose that the mortality had been caused by malaria, and this supposition is all the more probable since malaria is to-day rife

among the population of the islands. He himself has visited the islands and found much malaria present. The islands themselves are principally flat, planted with cocoanut palms and surrounded by deep water, and again, at a distance of five hundred or a thousand yards from the coast, by a coral reef.

There is on the island of Grand Marimon only a single permanent source of fresh water which has only one restricted outlet; so that during the dry season there is no mingling of fresh water with sea water, and there exist during the dry season many pools of dead sea water, peopled with *Anopheles* larvae, containing not less than three per cent. of sodium chloride, and which then must be considered as concentrated sea water.

Continuing his researches at Samarang, Dr. Vogel found other pools of water inhabited by *Anopheles* larvae, in proximity to the sea. One of these places had a surface of 20 to 30 square meters and a depth of from 10 to 30 centimeters. It was connected with a pool of sea water by a bamboo pipe crossing the dike. The pool is thus invaded by seaweeds, but the fish can not enter. These places swarm with *Anopheles* larvae, while *Culex* larvae are not found there. In this pool the percentage of sodium chloride is about 2.88, while in the water of the neighboring swamps it varies between 2.44 and 2.76.

Other instances are given with careful descriptions and the author finally draws the following conclusions:

1. There are species of *Anopheles* which can live very well in sea water.
2. These mosquitoes lay eggs which develop even in sea water which has been evaporated to half its original quantity.
3. These larvae in the gradually evaporating pools of sea water can stand an evaporation of the water to one third of its bulk, but do not appear to transform to adults if the concentration be greater than this.
4. The larvae coming from eggs laid in sea water of high concentration can accomplish their entire metamorphoses in almost the normal time. This is true even when the water has such concentration that the development of larvae originally hatching in un-

concentrated sea water would be retarded by this salt water.

Not only are these observations of great interest as bearing upon the health of certain seacoasts, but they have an important bearing in possibly explaining the cases of malaria observed upon sailing vessels that have not made port for months, since it indicates the possibility that *Anopheles* may breed in the bilge-water of such vessels. In such cases it is only necessary that one of the sailors should have gametes in his blood in order to start an epidemic of malaria aboard the vessel. The bad reputation which the coral islands of farther India have is explained by Doctor Vogel's observations, since so many cases of malaria are observed along the coast during the dry season when all the rivers and fresh-water streams are dried up.

The proposed destruction of *Anopheles* by the introduction of sea water seems not to be rational.

Good tidal ponds exercise a favorable influence upon the malarial death rate, but when these are infected, or even where the water is permitted to form isolated stagnant pools, the mortality from malaria reaches a high figure, as has been observed at Samarang. Villages near the sea, in the middle of tidal pools have had during a period of ten years an average mortality of from 1 to 4 per cent. each year. In villages further away from the sea, where the ponds have been abandoned or neglected and the sea water is, therefore, isolated, there is a mortality which varies from 8 to 10 per cent. each year. The pools in these regions during the dry season have a proportion of sea salt equal to that of the ocean from which they get their water. In this dry season the death rate is greatest, and this is exclusively due to the sea water ponds.

The great mortality is surely due to malaria; since almost without exception the cases of pernicious malaria or haemoglobinuria which are treated at Samarang come from the south border of tidal pools. A quarter of Samarang called Zeestrand was inhabited by well-to-do citizens of the city who had good health, although surrounded by pools. Then, on account of the banking up of the coast,

these pools were left further from the sea, and the inhabitants were forced to quit the quarter because the death rate from malaria reached terrible proportions. The empty houses of this quarter still bear witness to past grandeur. The mortality of the indigenous population which still remains there has been on the average during the last ten years 9.7 per cent. per year.

L. O. HOWARD

SCIENTIFIC NOTES AND NEWS

DR. HENRY FAIRFIELD OSBORN, one of the vice-presidents of the American Museum of Natural History and curator of vertebrate paleontology, has been elected president of the museum to succeed the late Morris K. Jesup.

THE University of Pennsylvania will confer the degree of doctor of laws on Mr. G. K. Gilbert, of the U. S. Geological Survey, on February 22. The annual university day address will be made by the Hon. Joseph H. Choate.

PROFESSOR ROBERT HELMERT, director of the Goedetic Institute at Potsdam, has been elected a corresponding member of the St. Petersburg Academy of Sciences.

LORD AVEBURY has been elected president of the Royal Microscopical Society, and will deliver an address on seeds, with especial reference to British plants, at the March meeting.

THE Association of American Geographers held its fourth annual meeting at Chicago during convocation week. The sessions lasted three days, including one joint session with Section E of the American Association. Forty-four papers were presented, this being the largest number yet offered at any meeting. Since the death of the society's president, Dr. Angelo Heilprin, the duties of this office have devolved upon the first vice-president, Professor Ralph S. Tarr. Officers elected for the coming year are G. K. Gilbert, president; R. D. Salisbury, first vice-president; Ellen C. Semple, second vice-president; A. P. Brigham, secretary; N. M. Fenneman, treasurer; R. S. Tarr, member of council. It was all but formally decided to hold the next annual meeting at New Haven.